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POSSIBILITIES FOR PRODUCING HIGH QUALITY RAW SILK AND FOSTERING A SKILLED WORK FORCE IN THE INDIAN SILK-REELING INDUSTRY*

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Abstract

India is one of the major countries of raw silk production in the world. But Indian raw silk is not exported at all because of its poor quality, not because of strong domestic demand. The poor quality of raw silk is true for not only the product from multivoltine cocoons in the indigenous sector, but also the product even from uni- or bivoltine cocoons in the modern filature sector with highly productive reeling machines. This fact implies that, to produce the quality raw silk, skilled labor under strict production control is more crucial than the quality of raw materials or the sophisticated machines.

This paper aims to uncover the insufficiency of production management in modern filatures, which consequently fails to foster well-organized skilled labor. Since such micro data to prove the fact are not available, we conducted the structured interview survey at 16 modern filatures. The results reveal the lack of quality consciousness among managerial staff as well as the shortage of skilled labor.

Introduction

India, along with China, Japan, Korea and the Soviet Union, is one of the major raw silk producing countries of the world with its production growing steadily from around 2 thousand tons (mulberry raw silk only) in the first half of the 1970s to over 5 thousand tons in the early 1980s. It is now the third largest producer of raw silk in the world.

India's position as a major sericulture country is not something new. For example, around the middle of the 19th century it was exporting about 1.5 million pounds of raw silk to England and other European countries. After that, however, while Japan and China quickly adopted factory-based mechanized silk-reeling technology, the Indian silk-reeling industry was left far behind in the race for modernization and stagnated. It was only in the late 1930s, when the world was getting grouped into blocks, that some hope, however

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slight, of revitalization of this industry emerged. This opportunity marked the turn around of the sericulture and silk-reeling industry in India. In the post-independence era, given the vitally important objective of employment creation and maintenance, it has been growing steadily as a representative rural industry under the auspices of an effective policy to protect the domestic market.

Historically India adopted the modern factory system of mechanized [steam-powered] silk-filatures at an early stage. In fact, by the end of the nineteenth century giant European style factories were already operating in Kashmir and Bengal, and the existence of quite a few mechanized filatures in Mysore and Madras at the end of the 1930s was also known. It may not, however, be an exaggeration to say that this mechanized filature sector, subdued by the competitive edge of hand-reeling sector using the primitive techniques of *charkha* or *ghai*, encountered a protracted period of stagnation. Today the modern sector has been placed under the protective custody of the state governments, and does not seem to show any signs of change.

In this paper we concentrate on the low quality of raw silk produced in the mechanized filatures as one of the major factors for its stagnation, and investigate the reasons why the modern filatures can not produce better quality raw silk than the hand-reeling sector. From a technological viewpoint the inferiority of the multivoltine cocoons used as the raw material and general obsolescence of machinery have been put forward as some reasons for the stagnation of the mechanized silk-reeling sector.[1] However, the problem of the labor force, especially the technical skills of silk reelers, has been more or less neglected.

While we are fully aware of the importance of cocoons and machinery, quality of raw silk through the rather simple process of silk reeling—disentangling baves [cocoon filaments: double brins] from a number of cocoons and cohering them to get a single thread —is critically dependent on the technological proficiency of silk-reelers as well.

In prewar Japan it was said that a silk-reeler required at least five years of experience on a standard sitting type reeling machine and 3-years on a multi-end reeling machine to be able to produce high quality raw silk.[2] In other words, silk-reeling was considered to be a typical example of work requiring technical skills, and a massive amount of effort and devices was expended by individual firms to nurture skilled workers. Skill-formation does not proceed merely on the basis of the perception or experience of the workers alone. The role of the production system as a whole (including process, work and quality controls) and the capabilities of middle management and the superintendents in integrating these processes together cannot be neglected as factors in bringing about appreciable progress in the skill-learning process. In this sense it is important to use a broad concept of skills, including their relationship with production management.[3] This paper discusses the problem of workers' skill-formation in the Indian mechanized silk-reeling industry from this point of view.

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[1] For example, Karasawa and Harada (1959) and Fact Finding Committee (1961) point out various reasons for the stagnation of the mechanized silk-reeling sector. While the former attaches greater importance to the inferior quality of cocoon strains, the latter emphasizes the obsolescence of the machinery and defects of firm organization.

[2] For details, see Kiyokawa (1988). In general, the capability and skill of silk-reelers were given considerable attention, and a number of surveys are available. See the note 22 of the paper.

[3] For a definition of the broad and the narrow concept of skills, see Kiyokawa (1991).

While we aim at investigating the problem of stagnation in the Indian mechanized filatures at the micro-economic level, the problems of the sericulture and silk-reeling industry in India have generally been treated in macroeconomic terms as an industry broadening employment opportunities in the rural areas.[4] The statistical material needed for a micro-economic study is practically impossible to use. One of the important features of this paper is the use of information of various silk-filatures collected through personal interviews based on a questionnaire.[5] Another feature of the study is its use of prewar Japanese experience as an implicit standard for comparative purposes, and to take into consideration the views of Japanese engineers and specialists actually involved in technical assistance to Indian filatures.[6]

I. *Raw Silk Production in India and Technological Background*

Before discussing the state of production management in individual filatures, it may be necessary to have an idea of the present state and technological level of the silk-reeling industry in India. This is because the Indian experience, characterized by extensive sericulture and silk-reeling in tropical areas, differs substantially from that of Japan in this respect, and some reservation needs to be qualified when we compare with the Japanese experience.

1. Mulberry vs Non-mulberry Silk

First of all, it must be noted that besides the mulberry silk-worm bred on mulberry, a substantial amount of non-mulberry silk-worms[7] like the Tussar (Indian Breed), Muga and Eri that grow on Sal, Champak, Ailantus, etc. are also bred in different parts of the country. The output of non-mulberry silk in India, though the second largest in the world after China, is no more than 10 percent of the output of mulberry silk (Figure 1). In 1982 the output of non-mulberry silk was 534 tons as compared to 5,214 tons of mulberry silk and it may safely be said that most of the Indian silk is mulberry silk. Discussion in the rest of this paper, therefore, is limited exclusively to the problems related to mulberry silk.

As depicted in Figure 2, while the principal mulberry silk producing areas are located in the states of Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu & Kashmir, production of non-mulberry silk is concentrated in states like Bihar, Assam, Orissa and Madhya Pradesh. Thus, except for parts of West Bengal and Andhra Pradesh, the production areas for the mulberry and non-mulberry silk do not overlap. Still, we believe

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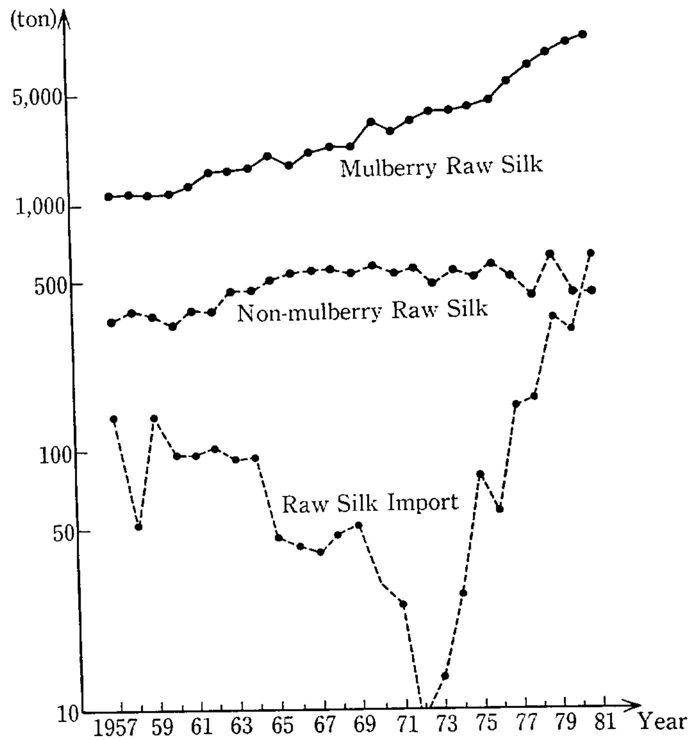
[4] Rajapurohit and Govindaraju (1981) is a typical example of such a study.

[5] The author is highly indebted to Drs. Arup Banerji, Pushpa Pathak, V. Balasubramanian (Central Silk Board) and Takashi Ōmura (formerly at Silk Conditioning House) for their assistance in the conduct of interview survey and express his deep gratitude to all of them.

[6] The author expresses his thanks to Drs. Seinosuke Ōmura (formerly at Tokyo University of Agriculture and Technology), Takashi Ōmura, Toshihisa Isobe (International Agricultural Cooperation Experts' Association) and Michio Mizuide (Sericulture Experimental Station), who kindly consented to be interviewed.

[7] Silk-worms bred on outdoor trees are normally categorized as wild silk-worms. However, since the Eri silk-worm is bred in the green house, all strains of silk-worms, except for Bombycidae, are categorized as non-mulberry silk-worms. See Sericulture Experimental Station (1981). For Indian wild silk-worm see Tasar Silk Committee (1966).

FIGURE 1. PRODUCTION AND IMPORT OF RAW SILK



Note: Year is the calendar year up to 1970, and the production year thereafter.
Source: 1957–70: Central Silk Board, *Silk in India, Statistical Biennial 1972;* 1971–81: *idem, Silk in India, Statistical Biennial 1984.*

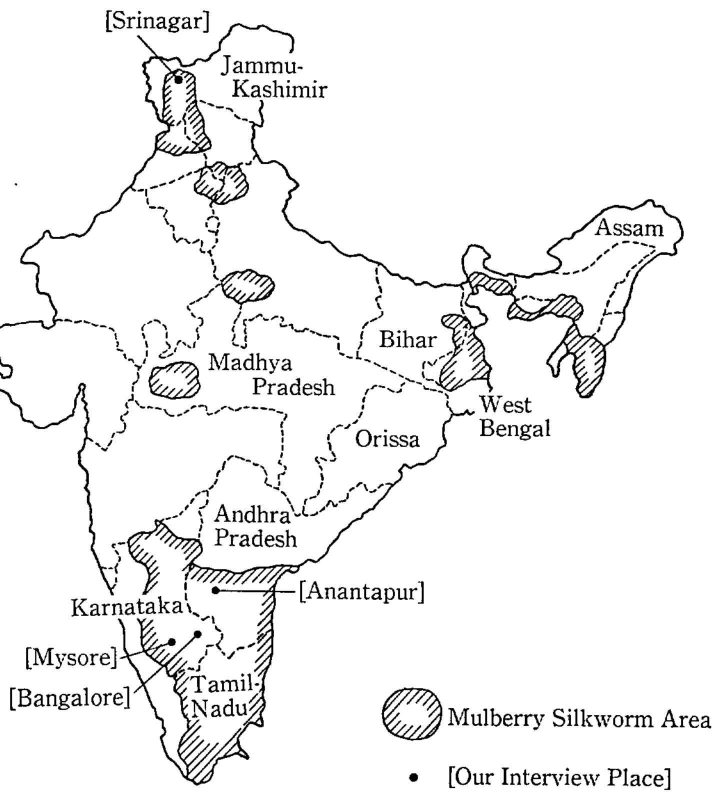
that the crude and primitive sericulture and silk-reeling techniques used for non-mulberry silk production are in some indirect way affecting the mulberry sericulture and reeling techniques that normally should be highly delicate and labor intensive. This is because the hand-reeling and the pierced-cocoon-reeling techniques used in West Bengal have traditionally resembled closely the non-mulberry silk-reeling techniques and do not yet show any signs of improvement.[8]

2. Multivoltine vs Bivoltine Silkworms

A second point to be noted is that, with a few exceptions, most of the Indian cocoons are multivoltine. For example, the Pure Mysore strain bred in Karnataka and other areas of southern India hatches 5–6 times a year and therefore is of extremely poor quality and small flossy cocoon with the length of cocoon thread of a mere 300–400 meter, the cocoon

[8] For example, see Mukerji (1903, 1905).

FIGURE 2. MAIN MULBERRY SILKWORM AREAS AND OUR SURVEY POINTS



shell ratio (weight) of 11–14 percent and a raw silk ratio per cocoon of about 7 percent. Similarly, the fluffy, yellowish multivoltine *Nistari* strain of West Bengal with the thread length of 300–350 meters, the shell ratio of 11–13 percent and a raw silk ratio of 5 percent is such a poor strain that it can in no way be compared to the Japanese cocoons (univoltine and bivoltine silkworms alone reared).

In addition, it is necessary to point out that since the multivoltine silkworms do not have a diapause period and the period between egg laying and eclosion is also short, it is very difficult to fully inspect or disinfect silkworm diseases and pests, to control the elosion timing of the male and female moths, or to adjust the timing of hatching climate conditions. For these reasons the selection of quality strains and to farm the efficient sericulture are almost unattainable targets for multivoltine silkworms.

On the other hand, while a descendant of an imported European strain and an indigenous strain known as *Barapalu* (both univoltine) respectively exist in Kashmir and West Bengal, not only is their proportion very small, but the quality is also far poorer than other temperate univoltine strains.

TABLE 1. PROPERTIES OF MULTIVOLTINE AND BIVOLTINE COCOONS

	Multivoltine	Bivoltine
1. Length of a Bave (m)	250–470	1,000–1,200
2. Size of a Bave (D)	1.5–1.9	2.4–3.0
3. Cocoon Shell Ratio (%)	10–13	18.4–19.7
4. Cocoon Yield (kg/100 DFL)	20	35
5. Quality of Raw Silk	Grade E	Grade A–B
6. Touch of Fabrics	Flossy	Soft
7. Controllability	Difficult	Easy

Note: Controllability means the possibility or easiness to control on artificial hatching, silkworm diseases, timing of hatching, etc.
Source: Produced from S. R. Vijay, "Bivoltine in the Tropics," paper presented to the 14th International Sericulture Congress, May 1984, Bangalore.

Thus, to produce high quality raw silk in India, improvement of the quality of the cocoons is the first and foremost condition. To achieve this a shift from multivoltine to bivoltine strains that are of better quality and more easily lend themselves to artificial controls, is indispensable. Table 1 clearly brings out the superiority of the bivoltine strains over the multivoltine strains. India has been studying the possibilities of a switch in this direction since the mid-seventies. Since 1980, a large-scale plan to increase the production of bivoltine strains has been implemented in Karnataka state with all out assistance from the World Bank. However, from that time until now, the plan objectives have been largely under-attained due to a lack of human resources, deficiency of cooling devices and insufficient price incentives.[9]

3. Modern Filatures vs Cottage Basins and Hand-reeling

The mechanized silk-filature sector based on the modern factory system is very small in the Indian silk-reeling industry and the major proportion of raw silk is produced by the hand-reeling sector using *charkha*, and by the cottage basin sector using standard sitting type reeling machines.

The Indian *charkha* used for the production of hand-reeled raw silk, is a crude and simple reeling device. A basin, placed on a large earthen hearth, serves both as a cooking and reeling basin from which extremely coarse 4–5 threads are directly reeled onto a reel with a perimeter of about two meters without using any traverse machanism. This is a large device operated by groups of two, a winder who rotates the reel by hand and a cooker-cum-reeler. Delicate silk-reeling, taking into consideration the reelability of cocoons, the temperature of the reeling-basin water and conditions of end-feeding, is impossible with this device. If we do not count the difference of product quality, the amount of raw silk produced is not necessarily low (see Tables 2 and 4). This device costs about 200–500 rupees and can be easily constructed by the traditional village craftsman and is normally operated outdoors by socially low-standing scheduled castes and scheduled tribes labor.

The cottage basin reeling sector is characterized by a wide degree of variation. In the simplest operations several hand-reeling devices are simply joined together. There

[9] For a discussion of the World Bank Project, see Hanumappa (1986), Chapters 2 and 5.

TABLE 2. A RESULT OF EXPERIMENTS FOR REELING AT CSTRI

	Experiment 1 (30D Raw Silk)		Experiment 2 (21D Raw Silk)	
	Automatic Reeling Machine	Improved Charkha	Automatic Reeling Machine	Automatic Reeling Machine
	Multivoltine	Multivoltine	Bivoltine	Multivoltine
Length of a Bave (m)	574	574	1,032	645
Size of a Bave (D)	2.39	2.39	2.79	2.56
Cocoon Shell Ratio (%)	16.9	16.9	20.5	15.8
Size of Raw Silk (D)	31.0	30.1	20.2	20.6
Renditta	10.7	9.8	8.5	10.6
Productivity per End (g)	152.0	172.0	109.0	91.0
Productivity per Reeler (g)	2,280	688	1,635	1,365

Note 1: Renditta is the quantity (kg) of the cocoons required for producing raw silk of 1 kg.
2: An *charkha* has 4 ends for each reeling unit and an automatic reeling machine has 15 ends.
Source: Central Silk Technological Research Institute, *Annual Report 1983–84*, c1984.

TABLE 3. RAW SILK PRICES OF THREE DIFFERENT SECTORS

	Hand-reeling Raw Silk	Cottage Basin Raw Silk	Modern Filature Raw Silk
			(Rps.)
1958	46.2– 73.7	—	80.3– 88.0
1959	48.4– 78.1	73.7– 84.7	82.0– 98.7
1960	51.5– 82.5	70.8– 85.8	85.8– 96.8
1966	92.9–119.4	101.6–144.0	97.5–139.0
1967	120.8–155.0	142.2–185.0	148.0–156.0
1968	107.8–152.3	143.3–185.0	145.0–156.2
1980	223.0–275.0	302.0–340.0	324.0–338.0
1981	315.0–436.0	425.0–487.0	437.0–452.0
1982	329.0–417.0	397.0–458.0	455.0–462.0

Note: The prices (Rps.) per kg at Bangalore market.
Sources: For 1958–60, Central Silk Board, *Report of the Fact Finding Committee on the Filature Silk Industry in India*, c1962; For 1966–68: Tariff Commission, *Report on the Continuance of Protection to the Sericulture Industry*, 1969; For 1980–82: Central Silk Board, *Silk in India: Statistical Biennial 1984*.

are other cottage basin workshops in which electric motors are used as power sources; these workshops resemble the kind of filatures with sitting type reeling machines that at one time were popular in Japan, only on a smaller scale. Technologically, this sector normally adopts a separate system of cooking and reeling, and uses the reeling machine equipped with a tavelette croisure, a traverse mechanism and steam-boiled water supply (in some cases, even with an end-feeder).

As a result the product of this sector also differs in quality, and the better quality silk is in no way inferior to that produced in large scale mechanized filatures; sometimes the only difference is the scale of production. In general, however, the technological level of the cottage industry reeling sector is somewhere in-between the hand-reeling sector and the modern factory type filature sector. This cottage industry sector is usually promoted

TABLE 4. RAW SILK QUALITY OF THREE DIFFERENT SECTORS

	Hand-reeling Raw Silk	Cottage Basin Raw Silk	Modern Filature Raw Silk
1. Evenness (%)	58.33	77.50	82.50
2. Low Evenness (%)	50.00	70.00	75.00
3. Cleanness (%)	58.33	50.00	98.33
4. Neatness (%)	70.00	68.33	65.00
5. Average Size (D)	22.00	23.00	21.00
6. Size Deviation (D)	2.83	2.12	0.71
7. Maximum Deviation (D)	3.87	3.25	1.25
8. Winding Breaks (No.)	16	3	3
9. Tenacity (g)	2.78	3.11	3.18
10. Elongation (%)	20.7	22.7	25.0
11. Cohesion (stroke)	32	38	32

Note: The results of testing each type of raw silk produced by different sectors, at the Silk Conditioning and Testing House, Bangalore.

Source: Central Silk Board, *Report of the Fact Finding Committee on the Filature Silk Industry in India*, c1962.

as the rural industry with "appropriate technology" which is able to both maximize income and employment in the rural sector.

On the other hand, the Indian modern factory type filatures, except for a few mini-model filatures set up for the purposes of dissemination and training, are usually large-scale filatures. Such factories maintain a fairly good level of machinery including multi-end reeling machines and the traditional Italian-sat type reeling machines. On the whole, obsolescence of machinery is visible but at times one can also see the light of modernization of equipment in the form of the introduction of automatic reeling machines from Japan and semi-automatic machines from Korea.

Thus, three sectors (the hand-reeling sector, the cottage basin sector and the modern filature sector) exist side by side in the Indian silk industry and are competing with one another. For example, the number of reeling units in the modern filature sector rose steadily from 1,878 in 1969 to 4,371 in 1977 and 5,143 in 1982. During the same period, however, the number of reeling units in the cottage industry sector rose from 2,901 to 5,553 to 6,879 and in the hand-reeling sector from 9,215 to 14,835 and then to 22,385, almost at the same pace. Thus, while in absolute terms the number of reeling units in the modern filature sector have risen 2.7 times, in terms of the silk industry as a whole its share is still only about 15 percent. The share of the hand-reeling sector is about 65 percent and the cottage industry sector is 20 percent. In this sense the modern filature sector seems to have stagnated.

Let us try to see whether or not the stagnation of the modern factory-type filature, in spite of various promotion measures, is a result of unavoidable using multivoltine cocoons on the mechanized reeling machines. Table 2 presents the results of an experiment carried out by the Central Silk Technological Research Institute (CSTRI) of Bangalore.[10] Ac-

[10] Interpretation of Table 2 requires at least four of the following reservations. That is, (1) the hand-reeling machine (*Charkha*) used was developed and improved by CSTRI. (2) The multivoltine cocoons used were of fairly high quality (Cf. Table 1). (3) The amount of silk reeled with automatic reeling machine was much higher than the actual productivity in the field. (4) Even with the above conditions, the productivity, in the bivoltine case, is no more than one third of its level in Japan.

cording to this experiment, in the case of 30 denier (D) thread, while an improved *charkha* (hand-reeling device) yields a greater amount per end, the per person productivity is much higher for the automatic reeling machine. Second, it is also seen that use of bivoltine cocoons on the automatic machine raises productivity as compared to multivoltine cocoons, but the rise in productivity is not very large. These results go to show that as far as volume produced is concerned, multivoltine cocoons do not specifically work to the detriment of modern filatures alone using delicate automatic or multi-end reeling machines. That is, use of multivoltine cocoons cannot be held directly and wholly responsible for the competitive pressure on the modern filature sector from the raw silk produced in the hand-reeling and the cottage industry sectors.

Given the technological conditions as discussed above, in Sections II and III below, we attempt to investigate the reasons for the stagnation of the modern filature sector from the viewpoint of production management.[11]

II. *The Level of Reeling Technology and Labor Quality as Revealed in the Results of the Survey of Silk Filatures*

1. The Reasons for the Slump in the Modern Filature Sector

We have seen that it is not possible to attribute the slump of the modern filature sector solely to the use of multivoltine cocoons as the raw material. Where should one, then, look for the main factors explaining such a state? A hint lies in the India's raw silk trade. As is evident from Figure 1, India does not export raw silk at all because of its poor quality. The imports are also subject to stringent import controls and only the imports of Grade A and other high quality raw silk, primarily imported from China for warps, are allowed so as not to compete with indigenous raw silk. In other words, the Indian raw silk not only does not have price competitiveness in the international markets but also is absolutely incapable of producing high grade raw silk. Here, we believe, is the underlying cause for accumulating deficits in the modern filature sector. Let us look at this point in some detail.

Table 3 presents the raw silk prices obtaining in different sectors. It is clear from this Table that, while there is a substantial difference between the hand-reeling and cottage basin sectors, the difference between the latter and the modern filature sector is only nominal. At times the cottage basin's prices even exceed those in the filature sector. This suggests that the quality of raw silk produced in the two sectors is not very different.

In fact, on the basis of International Standards, Indian filature-made raw silk is believed to barely make it to Grade D to E (International Silk Association's Grading), and will not even come up to Grade C.[12] Though slightly dated, Table 4 also confirms the above

[11] Production management in this paper is defined in its broad sense and includes process control, quality control and work control.

[12] For example, [Govt. of] West Bengal, Directorate of Industries (1950, p. 18), Tariff Commission (1953, p. 30), Karasawa and Harada (1959, p. 67), Nanavaty (1965, p. 74).

observations. In interpreting this Table, taking into account the differences in the quality of machinery, it is possible to say, as is also pointed out by the Tariff Commission Report, that silk-reeling in the cottage industry probably pays greater attention to the quality of raw silk than the factory-based reeling filatures.[13]

On the other hand, it is alleged that the modern filature sector was at a disadvantage in the purchase of raw cocoons as compared to the cottage basin sector or the hand-reeling sector.[14] Given the differences in fixed capital costs and production organization or legal controls, etc., the modern filature sector needed a 50 rupee price differential of raw silk (per kg) in order to be able to compete with the cottage industry silk-reeling sector.[15] In spite of this, the quality of raw silk produced by the modern filature sector did not differ substantially from that of the cottage basin sector. As a result, since the price differential was not sufficiently large, the business of the factory-based silk-reelers had to slump. Thus, it becomes imperative to investigate the question of why, despite it's superior machinery, the factory-based reeling filatures could not produce better quality raw silk. The low quality of cocoons may have something to do with it but, as we have already confirmed, this factor did not act in a detrimental fashion for the filature sector alone.[16] This naturally leads us to focus on the second aspect of the problem, namely, the shortage of a skilled work-force and defects in work management.[17] In the following pages we will discuss this problem in greater details on the basis of the result obtained from our own survey.

2. The Scope of the Survey

With the above objective in mind, we conducted an interview survey of modern filatures with respect to the formation of a skilled work-force and production management during the period from the end of 1986 to early 1987. Of the factories surveyed, a total of 7, including 4 plants (Kollegal, Mamballi, Chamarajanagar and Santhemahalli) run by the Karnataka State Government, T. Narashpura and Kanakapura plants of Karnataka Silk Industries Corporation (KSIC) and the Srinagar plant run by the Government of Jammu and Kashmir, are important as full fledged large-scale filatures. In addition, Veerabhadreshwara filature (in Mandya district), and the state government managed mini-filature (Tholakanse district) in Karnataka, 4 Training and Demonstration Units established under the development plan of Andhra Pradesh in Anantapur district, 2 state-run small-scale filatures in Vizag and Vikravad districts of Andhra Pradesh, the Semi-Automatic Reeling Center, a total of 9 plants were also surveyed bringing the total coverage to 16 plants. The plants covered range from plants with a long history like the Srinagar plant which was established in 1889, to plants like the Training and Demonstration Units in Andhra Pradesh, established in the past few years. We have purposefully given greater attention to the questionnaire responses from the 7 large scale filatures which have played a leading role

[13] Tariff Commission (1969, p. 48).

[14] Fact Finding Committee (1961, pp. 29–30), B. S. Srikantaradhya, "Silk Filature: Performance and Prospects," in Aziz and Hanumappa (1985, p. 71).

[15] Tariff Commission (1969, pp. 33–34), as quoted in the Report of the Filature Committee.

[16] In general, raw silk from multivoltine cocoons was valued at about twenty rupees (per kg) less than that from bivoltine cocoons (in the late 1960's). See Tariff Commission (1969, p. 51).

[17] For example, Tariff Commission (1969, p. 48), and Fact Finding Committee (1961, pp. 68–69).

in the industry. Among these 7, the Kollegal filature run by the Karnataka State Government may be regarded as the most typical filature in India in various respects.

3. Labor Productivity and Reeling Technology

Let us begin by looking at the labor productivity of reeling hands, a fairly good indicator of the general level of reeling technology. The reeling efficiency per day shows a wide variation from 450 grams to 2,100 grams. For example a standard filature like the Kollegal, which is equipped with old, sitting type reeling machines (with 464 units; indigenously produced in 1937) uses the traditional Italian system which disconnects cooking and reeling, i.e. a single reeler is made responsible for 6 reeling-ends and a cocoon cooker who cooks with a small basin and supplies cocoons is designated for every two reelers. The average amount of silk reeled per head under this system is relatively high at 800–850 grams of 21 denier thread.[18]

This is much higher than the average of 550 grams for the Srinagar filature using the same sitting type machines with a division of labor between cooking and reeling (8 ends; 306 units, Italian machine of 1916 vintage). If we also take into account the fact that the mini-filatures equipped with new multi-end reeling machines in the Anantapur district give an average of 450–600 grams, the Kollegal may be classified in the superior group for silk reeled with conventional sitting type reeling machines.

The Narashpura filature run by KSIC, undertook a complete modernization of its equipment with the help of World Bank loans in 1984, introducing cocoon cooking and drying machines from Japan and Korea as well as automatic reeling machine (20-end, Japanese make) and semi-automatic reeling machine (15-end, Korean make). As a result, reeling efficiency per end has risen to 120–140 grams and exceeded 2 kilograms per reeler. Except for a few such exceptions (the Kanakapura filature is also quite close to this), generally, there seems to much room for improving the reeling efficiency per head as well as the quality of the product. The very fact that in spite of using univoltine and bivoltine cocoons (strains imported from Japan), the amount and quality of the raw silk produced at the Srinagar filature does not differ much from that produced using multivoltine cocoons at other filatures, indicates the existence of a problem at a more fundamental level.

If we look at the equipment used in attaining such a level of productivity, we find that while half of the filatures use cocoon dryers (3 Japanese; 1 Korean and 4 indigenous makes), only three filatures are equipped with cooking machines (2 Japanese and 2 Korean makes), even though this is one of the core processes in the silk-reeling technology. The other filatures still use the primitive cooking basin techniques.

As for the winding system, with the shift in the Srinagar filature in 1984 from the typical Italian direct reeling method to the Japanese re-reeling method, almost all filatures (with one exception) are now using the re-reeling system. It should be noted, however, that in spite of adopting this system, the individual-based reeled silk inspection is rarely undertaken. It may not be necessary to repeat that a large proportion of filatures in Karnataka and Andhra Pradesh use multivoltine cocoons. Unequivocal efforts by the governments

[18] The general average is considered to be 550–700 grams. See Strikantaradhya, *op. cit.* [Aziz and Hanumappa (1985, p. 69)].

have failed to achieve any substantial use of bivoltine cocoons. That is, even in the most advanced Narashpura filature, bivoltine cocoons form only 30 percent of the total cocoon consumption. It goes without saying that other filatures either do not use the bivoltine cocoons at all or at the most use it for between 10 to 20 percent of their requirements. It is true that bivoltine cocoons do display various superior traits as compared to multivoltine cocoons (see Table 1) but a mixing of the two completely different strains, even for a short period, is not desirable at all. This is because there are substantial differences in the quality of two types of cocoons. Proper treatment of each type of cocoon for production of reasonable quality silk naturally requires different cooking time and temperature, speed of reeling, temperature of reeling-basin water, control of end-feeding and so forth. These adjustments demand also very difficult adaptations by the supervisors and workers. Stated alternatively, the very fact that cocoons of two widely different qualities are thrown together in a filature indicates the extent to which quality considerations (or cost considerations) are being neglected.

To wind up the discussion in this section, let us mention two further points with respect to technology. First, as for the reeling method, all except 4 of the filatures use the floating method. In general, however, this method is not suited to reeling quality raw silk. In the case of operating multi-end reeling machines, the temperature of reeling-basin water is excessively high (40–60°C), and particularly the floating method with high temperature cannot bring out the advantage of multi-end reeling machines of producing high quality raw silk.

On the other hand, in the case of using conventional sitting type reeling machines, the number of ends attended by a single reeler is also excessive (6–8 ends). Production of high grade raw silk requires sufficient training with a smaller number of ends and then a gradual increase to the maximum of 6–8 ends. Especially in the case of multivoltine cocoons, which have extremely fine filaments, a 21 denier thread requires about 10–15 cocoons. Therefore, even with the fixed number (of cocoons) reeling method, control of end-feeding and basin arrangement is difficult even for one end, and it is not an exaggeration to say that proper control of all the 8 ends is an almost impossible task.

4. The Quality of the Labor-force and the Working Environment

The level of reeling technology depends on the quality of cocoons and the vintage of machinery but, in the case of such a labor-intensive good as raw silk, productivity and product quality can be significantly affected by the availability of a skilled work-force. Let us next discuss briefly the quality of the work force and the working environment that is a precondition for the formation of skilled labor in broader sense.

As evidenced in the Japanese and the Chinese experiences, for a reeler who is required extreme dexterity, perseverance and concentration, the young female work force is considered most appropriate once training problems are solved. In fact, even in India most of reeling work force is composed of female workers. But, in contrast to the Japanese and Chinese cases, the proportion of male workers is rather high and is still higher if workers other than reelers are included. This is a direct reflection of general conditions in the Indian labor market and has nothing to do with the aptitude of Indian male workers.

The Srinagar filature is an extreme example of this phenomenon. At that filature the whole work force, including reelers, is composed of male workers. But the Kollegal and the Narashpura filatures are more representative of the general situation. At the Kollegal 75% of the total work force, and 84% of the reelers are women, while at the Narashpura 69% of the work force are women. We should note, however, that in India much of the female work force is made up of older, married women workers. This, again, is a reflection of excess supply of labor in the Indian labor market. Once a worker finds employment, that job is desperately defended. The result is long years of service, and as a consequence a rise in the average age of the work force.

Though not based on exact statistical results, the responses reveal that in older filatures the average age is around 35–45 years (no significant male-female differences) and the length of service also ranges from 20 to 30 years. In the recently established mini-filatures, however, the average age of the workers at 20–25 years is much younger and the turnover rate is also nearly zero.[19] Most of the workers are recruited from the area in which the filature is located or nearby areas, and workers are in principle expected to commute to work from their own residence. The dormitory system, which was common in Japan, is thoroughly non-existent.

Direct handling of chrysalis or moths is considered a dirty job in Indian society (and the labor conditions for this work are also bad) and, as a result, the workers employed in silk-reeling are from the lowermost echelons of society. That is, most of these workers are from the scheduled castes, tribes and Muslims.[20] Our survey results also confirm this observation.[21]

Due to their position, their education level is also bound to be lower than the average for the society. In the large-scale filatures with a high proportion of middle-aged workers, the number of primary school graduates is negligible (both males and females) and illiteracy rate is as high as 83 percent for males and 92 percent for females. In the mini-filatures employing mainly young workers, however, the proportion of primary and middle school graduates is fairly high but still one third of the female workers have no schooling and the illiteracy rate is high at 38 percent.

The Japanese experience does not reveal any causal relation or correlation between school record or intelligence quotient and labor productivity.[22] The low level of schooling or high illiteracy rates in India cannot, in themselves, be considered impeding factors in the formation of a skilled work-force. But, in general, since education can speed up acquisition of skill and provide adaptability to well-organized gang work, the lack of education may act as a hindering factor. Whatever the case may be, the most decisive factor for promoting skill is the attitude of the management and supervisors towards skill-formation rather than problems with the work force.

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[19] In the case of mini-filatures, since the workers are hired on a daily basis, the turnover rate, in real terms, is negligible. On the other hand, in large-scale filatures, the whole work-force is on a permanent basis with no temporary or daily workers. In both cases, since turnover rates are extremely low, the problem of trainees is not so important.

[20] Same is true for the hand-reeling and the cottage basin sectors. Rajapurohit and Govindaraju (1981, p. 71),

[21] For example, besides the *Bhagata* and *Valmiki* tribes, *Madigas*, *Malas*, *Kurubas* etc. are all composed of socially low strata. In Srinagar, *Butts*, *Lones* and *Dars* form the core.

[22] Though one does not find a strong correlation, there seems to be regarded as a necessary condition for disciplined labor. See Tamura (1916), Taniguchi (1929), Ishida (1936).

Let us now turn our attention to work environment. First, given the nature of the work, a single 8 hour shift system is extensively adopted with working hours from 8 A.M. to 5 P.M.. As the Indian silk filatures are usually troubled by shortages of cocoon supplies and high absenteeism among the workers, overtime work, even during heavy work-load periods is rare. Since multivoltine cocoons are available throughout the year, the working days are, in principle, around 300 (298–311) days a year. As for holidays, besides Sundays, the large-scale filatures which come under the purview of the factory law, allow 15 national holidays and 22–25 days of paid leave as well as monthly physiological leave.[23]

Thus, labor conditions in Indian silk-reeling filatures are more lax than those for prewar Japan. In Japan, a 12–14 hour work shift beginning at 5 or 6 A.M. and ending at 6 or 7 P.M. in the evening was the norm and the only a few yearly holidays for festivals except for two a month and some national holidays were allowed in the operation season. Moreover, the intensity of work was extremely high since competition among the workers was encouraged. In this sense, working conditions (barring wages) were far more stringent than in India at present. However, the welfare facilities that were considered to be very poor at that time, may have been superior to those obtaining in India.[24]

In India even large-scale filatures are, in principle, equipped only with toilet and drinking water, though a few have a mess-room and a clinic or a simple creche.[25] Filatures with supplementary education facilities or recreation rooms or some form of mutual aid association system are almost non-existent.

By this, however, we do not imply that these poor working conditions or the lowly educated work force has directly contributed to the inferior product quality in Indian factory-based reeling filaures. A look back at the Japanese experience shows that even under such conditions, it is perfectly possible to build up a fairly skilled work-force and if, in fact, such a skilled work-force has failed to emerge, the problem perhaps lies somewhere else. That is, in the final analysis, the blame has to rest mainly with the problems of production management in the broad sense.

III. *Production Management as A Necessary Condition for Producing High Grade Raw Silk*

1. Wage Structure Non-Conducive to Quality Improvements

Let us now provide some details of the state of production management and the problem of middle management and supervisors in the silk-reeling filatures.

To begin with, it may be said that the wage system has failed to incorporate the significance of product quality sufficiently and hence is non-conducive for affecting quality

[23] In the case of the Srinagar filature, besides Sundays, six national holidays and three religion-related holidays are approved. In the case of mini-filatures that do not fall under purview of factory law, only two holidays (January 26 and August 15) besides Sundays are allowed.

[24] For example, see Katsura (1928).

[25] Two filatures have clinics, five have mess-rooms and four have simple creches.

improvements. For example, the average wage of a reeler at 550–750 rupees differs substantially among the filatures, but does not show much differentiation within a single filature. This is because the wages in principle are paid as a time-rate,[26] to which only a dearness allowance is added.[27] Seniority wages are almost non-existent.[28] As a result, the wage system for rewards (bonuses) and punishments (fines) is also very crude; only when the size of the thread deviates widely from the assigned target size, wages for half a day or one day are withheld as penalty.

Such a wage structure differs substantially from the Japanese experience. In the case of Japan, the wage system emphasized product quality and piece-rate wages were paid in accordance with both the amount produced and the quality, after each individual's product was strictly inspected in detail. More specifically, a strict sampling test for daily product of each reeler was conducted with respect to cleanness & neatness, number of breaks, cohesion, the amount produced, raw silk ratio of cocoon, evenness variation (from the 1920's) as well as size deviation. The wages were paid according to the quality thus determined. Moreover, the system tended to promote competition among the reelers by evaluating some of the inspection items like the amount produced and raw-silk ratio in terms of deviation from the average for the filature, i.e. by the zero-sum competition system.

It is true that some of the Indian filatures encourage competition among the reelers, but with a lack of an institutional back-up to promote and guarantee it, its effectiveness is questionable. The strict sampling inspection for every individual as carried out in Japan, is almost impossible if the re-reeling method is not used. However, if there is a will to strengthen the in-plant inspection, the technological requirements are sufficiently met in India since every filature is using the re-reeling method. Thus, the very fact that such inspections are not being carried out or the fact that the wage system does not match these requirements implies that there is no will on the part of management to implement it.

On the other hand, most of the Indian filatures also have a bonus system for regular attendance. Despite this, the rate of absenteeism is fairly high[29] and generally reaches 7 to 10 percent. The rate is especially high during the busy agricultural season and it is said that it touches 30 percent in Srinagar filature, and 14 percent in Mamballi filature. Moreover, as mentioned earlier, since the filatures refrain from using temporary workers, the machine utilization rates, during this period, naturally decline. Thus, labor management in Indian silk-reeling filatures is not sufficiently strict and it is difficult to say that a really committed or disciplined labor force is being nurtured.

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[26] In five filatures (all mini-filatures), standard amount for reeling (e.g. 600 grams for 19D thread) is set and a system of rewards and punishment (of one rupee for a 100 gram deviation from the standard) is in operation. Those wages may not be, hence, interpreted simply as time-rate. In general, the recommendation of a shift from time to piece-rate (though product quality is not referred to) was given much earlier. Fact Finding Committee (1961, p. 93), [Gov. of] India, Labor Bureau (1961). However, the long-rooted practices are not easily expected to break up. Deshpande (1945).

[27] Dearness allowance (or cost of living allowance) amount to about 50 percent of the basic wage. Since the mini-filatıures in Andhra Pradesh pay purely on a daily basis, the wage level is exceptionally low at 225–350 rupees per month.

[28] Only three filatures have a system of seniority bonuses for 10 years service but the amount is exceptionally small. In other filatures, seniority wage payments simply do not exist.

[29] In mini-filatures, because of the daily wage system, absenteeism is minimal and there is no reward for regular attendance. The absenteeism rates in other filatures have not been improved since the times of the survey by the Fact Finding Committee (1961, p. 66).

2. Characteristics of Management and Its Problems

Next, let us discuss the managerial class involved in labor management, quality control and process control. Each filature is headed by a mill director or a general manager who leads a small group of middle managers like an engineering manager, a labor officer and a chief accountant who in turn are in charge of the floor supervisors.[30] The supervisors, known as *Vicharka* in Karnataka and *Nigran* in Kashmir, are attached to from 5 to 15 reeling units. Thus, in numerical terms, the middle managers and supervisors are not only sufficient but are excessive when compared with Japan.

Except for some filatures like the Narashpura filature with automatic reeling machines, the number of supervisory staff per 100 reeling units varies from 18–23 in most cases. As extreme examples, the Kollegal filature has 26 supervisory staff for 464 units and the Srinagar filature 57 staff for 288 units. The ratio is excessive in general when compared to 4–6 staff per 100 units in the case of Japan.[31] The same can be observed in the Central Silk Board's report even for a recommended plan of a model filature.[32] We must point out that a large supervisory force does not in any way insure strict and effective process control and can be an excessive drain on production costs.

Since the supervisors are directly responsible for guidance and supervision of the workers, in most cases they are of the same caste as the workers. The only difference is their educational attainments. Generally they are high school graduates. Corresponding to this, their wages are also set at a level higher than the maximum of the ordinary workers. According to our survey, all the supervisors had 10-years of working experience in the reeling section but this does not necessarily imply that they were promoted from the class of general reeling workers (consider the difference in educational level). However, since they do not have any specific technical training at all in order to become supervisors, their supervisorship must have been restricted to simple self-learned OJT. Here, again, one may find a hidden reason for the lack of sufficiently rigorous and rational technical guidance for silk-reelers.

Middle management is mostly composed of university graduates from Mysore or Bangalore University and are of a caste completely higher than that of the workers. It is said that these middle managers, while having sufficiently high theoretical knowledge, have poor practical knowledge and also do not necessarily possess sufficient information of concrete technology. As a result, there are rarely any concrete proposals or technical suggestions to improve productivity from this segment and it is said that they never visit the production floor to provide technical guidance on their own.[33] We should note here

[30] In the case of mini-filatures, the factory manager is followed immediately by supervisors.

[31] This proportion is higher for mini-filatures. Figures for Japan represent the author's calculations from the data in Ministry of Agriculture and Commerce, *Zenkoku seishi kōjō chōsa* [National survey of silk-reeling filatures] (various years). In the case of multi-end reeling machines, the figure is 3 supervisors per 100 reeling units. Silk technology is generally divisible and can be considered to be constant returns to scale.

[32] 15 supervisors per 100 reeling units, Fact Finding Committee (1961, p. 103). Similarly, the fact that the proportion of non-reeling section workers is far higher (150 workers per 100 reeling units in the Model filature mentioned earlier, and around 160 in general) when compared to Japan (30–50 workers per 100 units), needs attention. In the recent model filature of the Central Silk Technological Research Institute, considerable improvement is seen as regards the superviros's ratio but relatively no improvement in the non-reeling worker's ratio.

that this is in sharp contrast to the role played by the engineers and technical staff graduating from engineering or textile colleges in the case of Japan.

In such a highly discontinuous job environment, even the mess-room and toilets for the supervisors who belong to the same caste as the workers are clearly marked. We can not believe that such a segregation in job structure is unrelated to the fact that detailed technical guidance and precise process control are not being undertaken to a sufficient extent.

3. Chief Engineer's Understanding of Silk-reeling Skill

Production management in Indian silk-reeling filatures may be beset with a number of problems. Particularly in producing high quality raw silk, management of the reeling process and work control may be considered to be the most important problems. Moreover, these problems are more on the managerial side or the management's understanding and attitude to them, rather than on the workers side. To have a better understanding of this problem, we begin by taking a look at the way the chief engineers (or technical in-charges) interpret the secrets of skills and reeling technology.

Table 5 summarizes the responses to the questions related to skills and reeling technology [III-18∼22: numbers correspond to the number in the quetionnaire]. According to this, all but the Srinagar filature consider the average time needed to acquire skills to be about half a year [III-19]. This is worth while to be noted, though the concept of skill may be affected by its definition and content [III-18]. Even if one grants, as the respondents believe, that skill may be measured not in an individual's experience and adaptability but by the objective criteria of stability of product quality and labor productivity,[34] the very fact that they believe that a worker can attain this level within half a year indicates that the expected product quality levels are exceptionally low.

As is evident from the fact that in Japan,[35] the time required to attain similar skill levels

TABLE 5. CHIEF ENGINEERS' UNDERSTANDING OF REELING SKILL

1. Standards of Skilledness	Stable product quality>(45) Quantity reeled (38)>Adaptability (24)> Experience (23)
2. Time Needed to Acquire Skill	1.33 years (0.47 years of Kashmir being excluded)
3. Core of Reeling Skill	Cocoon control (35.5)>Cooking (32.5)>Feeding ends (27)
4. Factors in Skill Acquisition	Individual aptitude (75)>Experience (68)> Production management (62)>Education/intelligence (49)>Mutual competition (34)> Standardized motion (22)
5. Content of Individual's Aptitude	Dexterity (58)>Health (55)>Perseverance (52)>Understanding ability (51)>Positive attitude (50)>Concentration (49)

* Numbers in parentheses are total scores awarded on the basis of responses.
Source: From interview survey sheets for chief engineers of 16 filatures.

[33] This observation is based on the opinions from Japanese experts who have the experience of a technical advisers in India.

[34] This understanding of skills differs a little from the general understanding. In Japan, objective levels were given from the management and skill was interpreted as some individual's factors that realized these levels. See Kiyokawa (1991).

[35] As for questions III-18∼22, we have also confirmed the corresponding Japanese experience by asking the same questions to those who have the experience of silk-reeling instructors in prewar Japanese silk-filatures (22 persons). For more detail, see Kiyokawa (1991).

was considered to be about five years in the case of sitting type reeling machines and over three years on multi-end reeling machines, there seems to be a substantial gap in the level of product quality expected by the filatures. If we remember that process and work controls were quite strict in Japan, it is easy to infer something about the grade of the products demanded by Indian filatures.

Next, the fact that cocoon control in the basin is considered to be the core of reeling technology [III-20] is easily understood if we keep in mind that extremely coarse thread is being produced from small multivoltine cocoons. Moreover, light-treatment of end-feeding evident in the responses is closely related to the fact that raw silk testing, including the seriplane tests, is not being properly carried out by individual filatures.

It is extremely interesting to note that as for individual traits facilitating the acquisition of the skills required [III-21], individual aptitudes and experience are emphasized, while the role of production management like motion studies is played down. This, at first sight seems to contradict the fact that individual traits were lightly treated in the context of the standards set for measuring skill levels. But given the fact that the individual traits may not form a sufficient condition in defining the concept of skill, this contradiction vanishes.

As for the contents of individual aptitudes [III-22], the factor most emphasized is that there are no substantial differences in the importance of the six alternative characteristics offered. In a relative sense, however, dexterity and health receive greater importance than concentration or attentiveness. Here, again, we can find another characteristic related to product quality in Indian silk-reeling filatures. Concentration or attentiveness, which was seen as very important in Japan, does not receive as much attention in India. This goes to show not only that the quality of filature-made raw silk produced in India does not require this trait to that much extent, but also indicates that the management does not have any intention to produce quality raw silk that requires a high degree of concentration or attentiveness.

4. Raw Silk Inspection and Reasons for Low-quality Silk

The above understanding of skills and reeling technology on the part of managers, naturally leads to insufficient awareness about the necessity of raw silk testing. This is because it is difficult to understand even the importance of raw silk testing, not to mention the need for strict quality control, unless one is ready to believe that product quality is decisively important for raw silk. This point was also stressed in the 1961 report of the Fact Finding Committee.

In 1961 the report of the committee, besides emphasizing the importance of the quality problem, suggested that (1) compulsory tests and grading, at least in the state government run filatures should be enforced in line with the national standards, IS (Indian Standard); and (2) each filature should undertake quality control, process control and time and motion studies for which training of technical specialists is necessary.[36] This report is a valuable document in terms of its high awareness of the importance of production management like quality control or work control. It is a pity, however, that even after the elapse of a quarter century, the fundamental problem remains the same.

[36] Fact Finding Committee (1961, pp. 50–51, 95–96).

The detailed standards for testing and grading of raw silk, in line with the standards of the International Silk Association, were established as early as 1953 in the form of national IS (Tentative) standards. Keeping in view the transactions in hand-reeled silk, testing and grading standards for the domestic market were also formulated at the same time. Finally, taking into account the emergence and growth of cottage basin sector, three different level IS standards came into existence in 1964.[37]

However, despite these grand standards, owing to that the absence of a market to economically evaluate the physical grading based on these tests, actual use of these standards has been negligible. In fact, even in the case of filatures which entrust quality tests to the silk conditioning and testing houses in Bangalore and Calcutta, the tests stop at simple conditioning and size tests, and full-scale grading test is rare. It is these circumstances that have led to a deterioration of product quality of factory-based reeling filatures and encourage the production of raw silk that is not much different from that produced in the hand-reeling and cottage basin sectors.

The results of our own survey also bring out the fact that very few filatures have installed equipments needed for regular raw silk tests. Only the Narashpura and the Srinagar filatures have moisture testers and seriplane machines while some others make do with the sizing reels only. In other words, it may not be an exaggeration to state that in-plant raw silk test in India is conspicuous by its absence.

We do not believe, as is often alleged, that the absence of a market to discriminate between different qualities is the main reason for the lack of raw silk tests even at the simplest level. This our belief stems from the fact that high-grade silk for warps is valued in its own right and is being imported. That is to say, we believe that the main reason for insufficiency of raw silk tests lies in the lack of management's awareness about the importance of quality of raw silk. Similarly, when regular tests of raw silk are not being undertaken, the blame for the low quality products of the silk-reeling filatures lies not with unskilled work force, but with a management that has failed to lay down the production management system conducive to quality improvement. That is, management must be held mainly responsible for failing to build up a skilled work-force capable of producing high-grade raw silk. In this sense, we agree with the Kerr, et al.'s statement[38] that "The skills and qualities of the working forces depend more upon what management does than on any innate characteristics of the workers themselves."

In Conclusion

In the end, let us try to place our conclusions in an overall perspective, and draw some policy implications. The most serious problem with India's factory-based silk-reeling filatures is the relative as well as absolute low quality of raw silk produced despite the availability of grandiose production equipment. A number of reasons can be cited for this

[37] The whole picture of testing and grading can be obtained from IS461-1953 for the Indian Standards (Tentative) of 1953 and from IS2938-1964 regarding the 1964 Standards. For the detailed method of different tests, see IS462-481-1953 and IS2939-2948-1964. Nanavaty (1965, pp. 161–65) provides a simple introduction.

[38] Clark Kerr, et al. (1960, p. 137). Especially Chapters 6 and 7.

state of affairs.

For example, one of these is the multivoltine cocoons used as raw material. But the inferiority of cocoons is common to all sectors of silk-reelers and does not affect the filature sector alone. On the other hand, the quality of raw silk produced in filatures using univoltine or bivoltine cocoons is not radically different. In addition, if we keep in mind the fact that the quality of raw silk produced in the Guangdong district of China, using similar multivoltine cocoons, far surpasses the quality of Indian raw silk, it can be safely said that inferiority of cocoons is not a decisive factor, though it is a large disadvantage.

A second factor may be the low quality of the work force drawn from lower social strata with low educational levels. But the experience of Japan and China indicates that as far as the labor force is concerned, very high quality is not a requirement. The problem, in essence, is to find a way to effectively organize the ordinary work force and to raise the quality of this work force through efficient work control, training and supervision.

Third, it is said that since most of the raw silk in India is used for making sarees, there is no necessity to produce high-grade thread and the factory-based reeling filatures do not have any incentive to produce high-grade raw silk. However, given the fact that high quality sarees get corresponding market price and are exported, and the fact that a part of the raw silk used in its production is imported, the argument that a market for high-grade raw silk is non-existent is not necessarily appropriate.

Therefore, we believe that the reason for the low quality of the raw silk produced in the filature sector lies neither in raw cocoons, nor in the labor force nor in the product market but in the management. There is a lack of awareness about "quality as the essence of raw silk" among the middle management and the supervisors and, as a result, the production management system is also not conducive to promoting quality improvements. In addition, due to the complacency arising out of its public sector position, entrepreneurial spirit and managerial effort is also lacking.

While a radical improvement in the structure and a shift to the production of high-grade silk in a short time is impossible, the following suggestions may be helpful in moving a step closer into this direction.

First, while traditionally exports of silk fabrics have been promoted, the assistance measures should be directed towards exports of *raw silk* too. That is, focus should be on fostering an awareness for quality by linking the domestic raw silk market with the international market. This is because a gradual increase in competitive edge through stepwise relaxation of import controls is the only way left for the survival of the factory-based reeling filatures in the long run.

Second, one way to strengthen competitiveness may be to expand the production of bivoltine silkworms, which the factory-based reeling filatures should exclusively use. Moreover, it is desirable to gradually shift from the conventional sitting type reeling machines to automatic reeling machines. In the meanwhile, the number of ends attended by each worker on the former machines, which is too many, should be reduced and efforts should be made to produce high-grade raw silk. Since use of multi-end reeling machines, in the absence of a strict production management conducive to quality improvements, can be a bigger drain on business operations than the use of conventional sitting type machines, a move towards improved production management or a shift to automatic and conventional reeling machines is desirable.

Finally, the restrictions on the hand-reeling sector, such as those in effect in Karnataka state at present, should be removed. This is because increased competition from the indigenous sector is the only means to increase productivity in the factory-based reeling filatures belonging to the public sector. In this sense, development of appropriate technology in the hand-reeling and cottage basin sectors should also be actively promoted and assisted.

In an environment where such competition promoting policies are being actively implemented, the management (in its broader sense) of the factory-based reeling filatures will be forced to comprehend the indispensability of technical skills for the production of high-grade raw silk. They will also realize that the development of such skills is dependent on their own production management adopted. The accumulation of *practical* technical knowledge by the management will enable them to provide strict technical control and guidance. While this represents a difficult task, it is the only way to solve the problem and survive competition.

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REFERENCE

Aziz, Abdul and H.G. Hanumappa, eds. (1985), *Silk Industry: Problems and Prospects*, New Delhi, Ashish Publishing House.

Deshpande, S.R. Labour Investigation Committee (1945), *Report on an Enquiry into Conditions of Labour in the Silk Industry in India*, Simla, Gov. of India.

Fact Finding Committee, Central Silk Board (c1961), *Report of the Fact Finding Committee on the Filature Silk Industry in India*, Bombay, Central Silk Board.

Hanumappa, H.G., ed. (1986), *Sericulture for Rural Development*, Bombay, Himalaya Publishing House.

India. Min. of Labour and Employment, Labour Bureau (c1961), *Incentive Systems: Principles and Practice in India*, [Simla], Gov. of India.

Ishida, Eikichi (1936), *Jokō no soshitu* [Aptitude of female labor], Nihon kōgyō kyōkai.

Karasawa, Shōhei and Tadatsugu Harada (1959), *Indo sanshigyō eno kyōryoku* [A cooperation in the Indian sericulture industry], Azia Kyōkai.

Katsura, Takashi (1928), *Hompō seishigyō rōdō jijyō* [Labor conditions in the Japanese silk-reeling industry], Chūō shokugyō shōkai jimukyoku.

Kerr, Clark, John T. Dunlop, Frederick H. Harbison, and Charles A. Myers (1960), *Industrialism and Industrial Man: The Problems of Labor and Management in Economic Growth*, Cambridge, Harvard U.P.

Kiyokawa, Yukihiko (1988), "Gijutsu chishiki o yūsuru kantokushasō no keisei to shijō eno tekiōka" [Formation of the educated supervisors class and market adaptations], *Shakai keizai shigaku* 54 (No. 3, Sept.).

Kiyokawa, Yukihiko (1991), "The Transformation of Young Rural Women into Disciplined Labor under Competition-oriented Management: The Experience of the Silk-Reeling Industry in Japan," *Hitotsubashi Journal of Economics* 32 (No. 2, Dec.).

Mukerji, N.G. (1903), *A Monograph on the Silk Fabrics of Bengal*, Calcutta, Bengal Secretariat Book Depot.

Mukerji, N.G. (1905), *Report on an Enquiry into the State of the Tasar Silk Industry in Bengal and the Central Provinces of India*, Calcutta, Bengal Secretariat Book Depot.

Nanavaty, Mahesh M. (1965), *Silk from Grub to Glamour*, Bombay, Paramount Publishing House.

Rajapurohit, A.R. and K.V. Govindaraju (1981), *A Study of Employment and Income in Sericulture*, Bangalore, Shiny Publications.

Sericulture Experimental Station, ed. (1981), *Indo no sanshigyō* [The sericulture industry in India], Sanshi shikenjō.

Sonwalkar, T.N. (1982), *Project on Silk Reeling: Cottage Basin, Multi-end Filature and Automatic Reeling Machine*, Bangalore, Central Silk Technological Research Institute, Gov. of India.

Tamura, Kumajiro (1916), *Seishikōjo yōseihō* [A training method of reeling hands], Gifuken seishi dōgyōkumiai.

Tanida, Masahide (1929), *Seishi jokō no nōryokuteki chōsa* [A competence test for silk reelers], Chuō shokugyō shōkai jimukyoku.

Tariff Commission, Gov. of India (1953), *Report on the Continuance of Protection to the Sericulture Industry*, Bombay, Gov. of India.

Tariff Commission, Gov. of India (1969), *Report on the Continuance of Protection to the Sericulture Industry*, Bombay, Gov. of India.

Tasar Silk Committee, Min. of Commerce, Gov. of India (1966), *Tasar Silk Industry in India: Report of the Tasar Silk Committee*, Bombay, Central Silk Board.

West Bengal, Directorate of Industries (1950), *Sericulture in West Bengal: A Review of the Position*, Calcutta, Gov. of West Bengal.

APPENDIX

QUESTIONNAIRE CONCERNING THE SKILL FORMATION AND LABOR MANAGEMENT IN THE SILK-REELING FILATURES IN INDIA**

I General Information on the Filature on the Whole
(Containing 17 questions: all omitted)

II Labor Management in the Reeling Section
(Containing 35 questions: all omitted)

III Technical Management in the Reeling Section
(Containing 22 questions: omitted up to Question 17)

18 What standard do you use for the "skilled reelers"? [What condition do you call "being skilled"?]

The high porduction of reeled silk □; Length of experience □; Stable quality of reeled silk □; Adaptability to changes in the cocoon conditions, etc. □;
Others □ ( )

19 How long does it take for a reeler to acquire such skill?
_____ year(s)

20 What is the most important in the reeling technique?
Feeding ends □; Cocoon control in the basin □; Cooking conditions □;
Others □ ( )

21 Promoting factors for skill formation. [Number in the order of importance]

( ) Level of education/intelligence;
( ) Aptitude of an individual;
( ) The length of experience;
( ) Technical management and control [e.g., stability in the machinery and cooking conditions];
( ) Mutual competition among workers and coercive pressure;
( ) Standardized motion/motion studies

22 What are the most important for a reeler among the individual aptitudes? [Number in the order of importance]

( ) Understanding of the mechanism of machinery and cooking conditions;
( ) Positive attitude in one's work;
( ) Patience in one's work;
( ) Ability to concentrate and attentiveness;
( ) Being skillful with one's fingers/being quick in one's motion;
( ) In good health.

** The interview questionnaire is abridged because of space limitation, but the full-scale questionnaire is available on request. Those who are interested in may write directly to the author at Hitotsubashi University, Tokyo, Japan.